DOCUMENT RESUME

ED 179 362 SE 028 778

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TITLE	Environmental Studies, Section I: Man's Effect on Nature. Learning Carrel Lesson 6.3: Urban Crisis. Study Guide and Script.
INSTITUTION	Texas Univ., Austin. Dept. of Geological Sciences.; Texas Univ., Austin. Science Education Center.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	[75]
GRANT	NSF-GY-9335-EZ
NOTE	44p.: For related documents, see SE 028 775-788
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Audiovisual Instruction: College Science: *Curriculum Development: *Earth Science: *Field Trips: *Higher Education: Individualized Instruction: Instructional Materials: Land Use: *Science Education: Science Instruction: Undergraduate Study: *Urban Environment

ABSTRACT

This is one of a series of 14 instructional components of a semester-long, environmental earth science course developed for undergraduate students. The course includes lectures, discussion sessions, and individualized learning carrel lessons. Presented are the study guide, script, and instructions for a field trip that relates land use strategies to the urban environment. The slides, audio-cassette tape, and other materials necessary to the lesson are not included. (BT)

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SCIENCE EDUCATION CENTER

ED179362

STUDY GUIDE AND SCRIPT

SECTION I: MAN'S EFFECT ON NATURE

LESSON 6.3: URBAN CRISIS

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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ENVIRONMENTAL STUDIES

A Cooperative Project of The Department of Geological Sciences and the Science Education Center

The University of Texas at Austin

SE 028 718

ENVIRONMENTAL EARTH SCIENCE

"Environmental Earth Science" is a new course developed at The University of Texas at Austin by the Department of Geological Sciences and the Science Education Center. It is offered at The University of Texas at Austin as Geology 361K and has been tried out during the spring semesters of 1972, 1973, 1974, and 1975. Revisions have been made as necessary after each tryout. The project within which the course has been developed has been supported by the National Science Foundation.

The course includes lectures, discussion sessions, and individualized Learning Carrel Lessons. Extensive use has been made of multi-media technology in the presentation of the course. Learning Carrels for individualized instruction have been especially designed for this program. The lectures introduce specific topics, suggest problems or questions, and provide background information. The discussion sessions provide the student an opportunity to ask questions and clarify ideas. The discussion sessions also provide input and feedback to the instructor.

The Learning Carrel Lessons have been written by faculty and graduate students in the geological sciences and in science education. Writers and resource contributors include Dr. Robert Boyer, Dr. Rolland Bartholomew, Dr. Keith Young, Dr. Samuel Ellison, Dr. James Underwood, Dr. David Butts, Dr. Addison E. Lee, David Keller, Melanie Lewis, Wayne Schade, Ann Lee, and William McLoda. Technicians involved in production of scripts, sound, and photography were Stan Prescott, Lee West, Charles Geffen, and William McLoda. Artists were Jesus Rivas, Alice Canestaro, Aly Knox, and Javier Flores.

Each Learning Carrel Lesson consists of a set of 2 x 2 slides, an audio cassette tape, a study guide, a script, and other materials necessary to the lesson. The study guide and script are in this booklet. Students may set their own time schedule within an announced period when slides and tapes are made available.

The student should note the list of Learning Carrel Lesson topics to place in proper content the lesson in this booklet, and then read carefully the introduction, rationale, prerequisites, and lesson objectives in the study guide. The student should follow the instructions in the study guide for the entire lesson. In some instances, these instructions are also repeated on the audio cassette tape. The slides and tapes have been synchronized to automatically advance the slides appropriate to the audiotape. However, there is a tone signal given before the change of each slide so that the lesson can be used outside of the carrel if automatic facilities are not available. When the student is ready to start the lesson, the "on" switch should be pushed. If the slides and tape are operated manually, both will need to be turned "on." The first slide is always a title slide or a blank solid colored slide. If

the slides and tape are manually operated, this title or blank slide should be on view before the tape is started. For automatic operation, the slides and tapes will be set up by the Instructor or Proctor before the lesson and between each use. It is most important to start each lesson according to these instructions in order to provide synchronization of the slides and tape. Remember that slides placed in the tray to be used with a rear view screen are reversed from those to be used with a front view screen.

The student will be instructed by the study guide and/or the tape to stop at various places to carry out certain activities. Usually the audio-tape will say, "Please stop the tape now and restart only when you have finished this exercise." Therefore, the student should wait a few seconds to finish hearing the instruction after the word "Stop." However, one should not wait long enough for the tone signal or automatic change to the next slide. This signal should be heard after you restart the tape. If the lesson is moving too rapidly, the student may stop the tape and slides at any time to consult the study guide or script, but it is NOT POSSIBLE to back up and re-examine a given slide without completing the entire cycle of the lesson.

It is particularly important for the student to carry out the instructions for activities given in the study guide. In order that a record may be maintained of these activities, each student should pick up a copy of the STUDENT RESPONSE SHEET which include questions to be answered and the other activities requiring responses. These should be completed and turned in to the instructor as required for grading, feedback for the instructor, and to provide a basis for student interaction in the discussion group.

Each Learning Carrel Lesson is independent within the context of the course. Some of them provide direct information on a given topic, but in an individualized mode requiring some activities and thought on the part of the student. Others place the student in a role-playing situation where some position must be taken on provocative questions or issues. Others deal primarily with applications of environmental information. In all the lessons, the student is expected to receive basic information that is coordinated with the lectures, the small group discussions, and the readings.

ENVIRONMENTAL EARTH SCIENCE

LEARNING CARREL LESSONS

Section I: Man's Effect on Nature

Lesson 6.1: Population
Lesson 6.2. Land Use
Lesson 6.3: Urban Crisis (Field Trip)

Section II: Energy

Lesson 6.4: Energy
Lesson 6.5: Energy Resources
Lesson 6.6: Future Projections

Section III: Processes Through Time

Lesson 6.7: Geologic Time
Lesson 6.8: Long Term Events
Lesson 6.9: Short Term Events

Section IV: Natural Resources

Lesson 6.10: Minerals
Lesson 6.11: Conflicts of Interest
Lesson 6.12: Soils
Lesson 6.13: Water

Section V: Oceanography

Lesson 6.14: Ocean Resources
Lesson 6.15: Pollution of the Oceans

STUDY GUIDE FOR LEARNING CARREL LESSON

6.3

URBAN CRISIS

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department
of Geological Sciences and the Science
Education Center

THE UNIVERSITY OF TEXAS AT AUSTIN

TO THE INSTRUCTOR:

This lesson differs from others in the series in that it provides for a field trip to six locations in Austin, Texas. However, as with the other lessons, it does have a Study Guide and Script of the audio cassette tape.

The Study Guide does provide travel instructions for each location. It also provides information and activities for the student at the end of the locations. The audio cassette tape provides additional information and activities.

Instructors in other cities who may wish to use this lesson should identify a field trip route and then transcribe a tape giving information and activities. Although it is recog[illegible]d that this tape cannot be properly used at other locations, it can serve as a model for other Instructors to develop their own lesson. It should be noted that a portable cassette tape player and tape will be required for this lesson.

TO THE STUDENT:

This booklet contains two sections: (1) the Student Study Guide for this lesson, and (2) the Script or printed copy of the discussion recorded on the audio cassette tape.

You are expected to begin with the printed instructions in the Study Guide and follow them continuously as you study the lesson. In many instances the same or similar instructions may also be heard on the audio cassette tape. Refer to the script only if you need to refresh your memory as to something that was said.

Specific instructions will be given in the Study Guide as to when to start and stop the tape. Do not restart the tape until instructed to do so in the Study Guide.

Questions requiring written answers should be completed on the STUDENT RESPONSE SHEETS provided by the Instructor.

INSTRUCTIONS:

1. Start the tape and listen to the remarks to introduce the lesson. STOP THE TAPE as indicated and read the Introduction, Rationale and Objectives for this lesson that follows. If you have questions, check with the Instructor or Proctor.

INTRODUCTION:

In Lesson 6.2--Land Use--you learned about problems that occur in planning for proper use of land for municipal areas. In this lesson you will visit some locations and make observations relating to land use strategies. In contrast to previous programs in which we brought information to you via slides, this program will ask you to travel to six locations in Austin.

Check out the field trip packet from your Proctor for one-half day periods. This packet includes: (1) a portable cassette tape player, and (2) a cassette tape. Your Proctor will give instructions for operating the tape recorder. You may stop and rewind the tape at any time to review. It is suggested that this field trip be taken in small groups. Check your classmates to see who could work with you conveniently.

Before you leave for your first stop, start the recorder and follow its instructions. The Study Guide includes directions and maps for getting to each location. It will also give you information pertaining to each of the sites and guide you through a series of activities.

RATIONALE:

This module is designed to illustrate actual examples of land use planning. It is designed to give you information relating to problems of environmental control and the responsibilities of cities in this area. Such information is important to you as a citizen, a voter, and a resident of the city you live in. Although this field trip will enable you to make observations and identify the problems in Austin, Texas, it is very likely that similar problems exist in other cities. Your study here should serve as an example of studies that could be made in other cities.

OBJECTIVES OF THIS LESSON:

Upon completion of this lesson you should be able to:

1. differentiate between three types of sanitary landfills
2. identify five hydrologic factors to be considered when planning a sanitary landfill site
3. using hydrological factors, construct an evaluation of a landfill site
4. predict the movement of rock supported by unstable clay over a period of several years
5. identify the effects of large scale cement dumping on the local environment
6. recommend an alternative to the present cement dump used in South Austin
7. describe the three stages of Biosorption water treatment
8. describe the three stages in the Eutrophication water treatment system
9. identify at least 1 advantage and 1 disadvantage of the Biosorption and Eutrophication systems
10. describe evidence of building settling and its causes

INSTRUCTIONS:

1. Restart the tape and listen until told to STOP THE TAPE and complete the activities listed under Frame 1. Study the information on solid waste disposal.

Frame 1

List as many different environmental problems as you can think of that a city government must face. (USE STUDENT RESPONSE SHEETS)

Solid Waste Disposal

Three of the problems that you should have included are solid waste disposal, sewage disposal, and problems with soil instability.

First look at the problem of solid waste disposal. In the United States the average citizen produces 6 to 8 pounds of solid wastes per day; this includes his personal contribution plus his pro-rata share of industrial and agricultural wastes. A city of 200,000 to 300,000 (Austin's population is 250,000) people is faced with collecting, transporting, and disposing of about 400 tons to 500 tons of solid wastes every day. This is the amount produced by the residents and small businesses; it does not include the wastes from big industrial operations.

How can these wastes be disposed of?--500 tons of solid waste each day for a city the size of Austin? This is one of the major problems that scientists are trying to answer. Considerable research is in progress to develop new, economic methods of collecting, transporting, and disposing of wastes. The average city dump contains substantial quantities of metals and other potentially valuable substances that might be recovered. Wastes might be converted to a useful building material by high-temperature, high-pressure conversion to a kind of brick or block.

Purification or sterilization of wastes by atomic radiation is under investigation. Long distance transport of solid wastes to fill abandoned mines and quarries in sparsely inhabited areas is contemplated by some large cities.

However, notwithstanding the new ideas and research in progress, the most satisfactory economic means of disposing of solid municipal wastes is the sanitary landfill. Unfortunately, in Texas there are still more open dumps than sanitary landfills. The practice of open burning of wastes at the disposal site has been discontinued in many areas because of air pollution control legislation. This increases the volume of material that must be buried. In some areas the volume of solid wastes is reduced by high temperature incinerators prior to ultimate disposal; in others controlled burning of wastes produces by-product steam. Currently in Texas some four municipal incinerators are in operation.

What makes the landfill "sanitary" is the practice of compacting and covering each day's accumulation of waste with a compacted layer of earth so that gases and fluids produced by chemical and biological action are restrained from escaping into the atmosphere or surface water and ground-water systems, and so that insects, rodents, and other animals are denied continued access to the wastes. The objective is to contain and isolate the fill; it should not be allowed to drain into surface or ground-water systems.

Sanitary landfilling consists of the basic operations of spreading, compacting, and covering. Over the years, two general methods of landfilling have evolved: the area method and the trench method. Some schools of thought also mention a third, the slope, or ramp method. In many operations, a slope, or ramp, is used in combination with the area or trench methods. For this reason, three methods will be described: area landfill, trench landfill, and ramp, or slope, method.

INSTRUCTIONS:

2. Restart the tape and study the illustrations and information on the following pages concerning Area Landfill, Trench Landfill, and Ramp Variation Landfill.

Figure 1

THE AREA METHOD

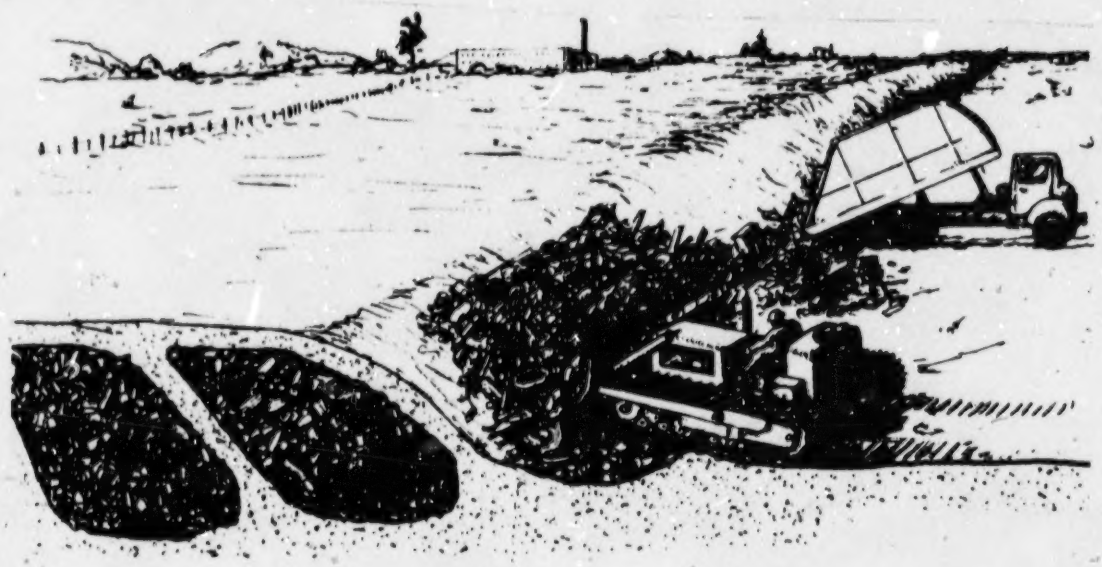
The bulldozer is spreading and compacting a load of solid waste. The scraper (foreground) is used to haul the cover material at the end of the day's operations. Note the portable fence that catches any blowing debris; these are used with any landfill method, whenever necessary.

Figure 2

THE TRENCH METHOD

The waste collection truck deposits its load into the trench where the bulldozer will spread and compact it. At the end of the day the dragline will excavate soil from the future trench, and this soil will be used as the daily cover material. Trenches can also be excavated with a front-end loader, bulldozer, or scraper.

Figure 3



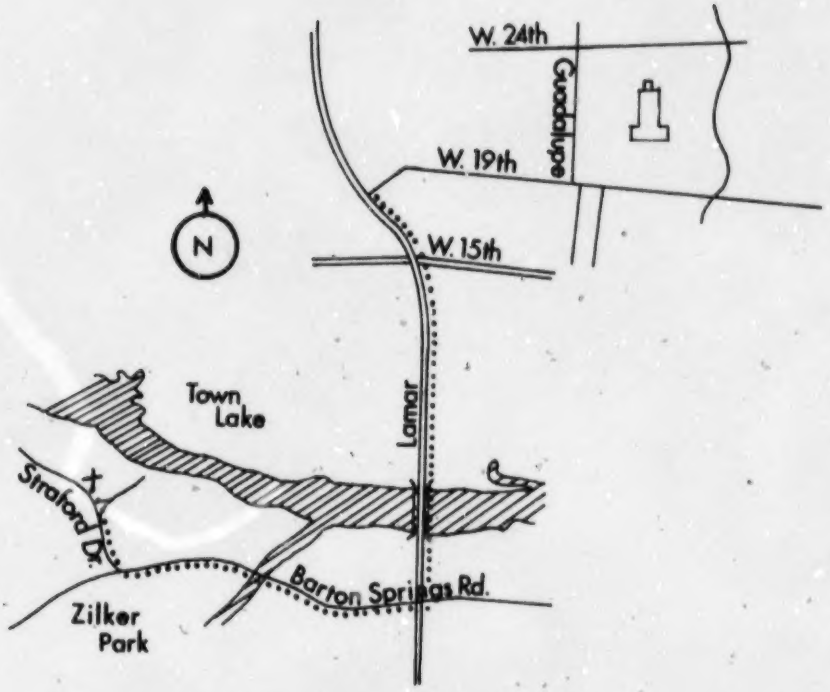
THE RAMP VARIATION

The solid wastes are being spread and compacted on a slope. The daily cell may be covered with earth scraped from the base of the ramp. This variation is used with either the area or trench method.

INSTRUCTIONS:

3. STOP THE TAPE. Follow the directions given on the following page and go to Stop 1, Zilker Park.

STOP 1 ZILKER PARK



To get to Zilker Park, go SOUTH on Lamar across the Town Lake Bridge and continue 0.3 miles to Barton Springs Road. Turn RIGHT on Barton Springs Road and go 0.9 miles to Straford Drive. Turn RIGHT on Straford Drive and go 0.2 miles. Pull on the dirt lane to the LEFT of the fireplug. You may leave your car parked here and walk around the site.

INSTRUCTIONS:

4. When you are at Stop 1, Zilker Park, restart the tape and and listen until told to study the criteria for evaluating the Zilker Park Landfill site. Then STOP THE TAPE and study the chart in Figure 4 and the description that follows.

Figure 4: Hydrologic Criteria for Evaluating Landfill Sites

Factors	Favorable	Unfavorable
Topography	Flat upland areas, heads of gullies and ravines, areas above potential flood levels	Depressions where water accumulates, lower reaches of gullies, flood plains of streams and sites where leachate might be discharged into streams or that might be inundated by floods.
Type of unconsolidated material	Clay, silt, and other relatively permeable material	Sand, gravel
Thickness of unconsolidated material above shallowest aquifer	50 feet or more; 30 feet or more if trenching is not involved	Less than 50 feet, less than 30 feet if no trenching is involved
Type of bedrock	Shale, chalk, clay, sand and gravel, sandstone, and metamorphic and igneous rock if not highly fractured	Fractured limestone, dolomite, or metamorphic and igneous rock
Sources and potential sources of ground water	Deep wells cased into bedrock or wells completed in sand and gravel with thick impermeable cover over aquifer, or dug wells if more than 500 feet from disposal site	Wells in shallow bedrock, particularly in limestone; wells completed in sand and gravel with thin cover over aquifer; improperly constructed deep wells in bedrock

Zilker Park Landfill Description

The original excavation for Zilker Park Landfill was a limestone quarry for gravel and road materials. This rock is extremely permeable and highly fractured. The depth of fill in this location is approximately 30 feet. At the time this landfill was started, Town Lake was not built and the water level was much lower. The level of ground water can be inferred to be close to lake level. The 1935 flood brought the water level to beyond Straford Drive. In 1957 a similar flood would have occurred if the level of Lake Travis had not been 65 feet below the spillway previous to a 24-inch rain over a period of 24 hours. There are no working water wells located within this vicinity.

Study the soil used to cover this site. Is this soil tightly compacted or would it permit rain water to permeate it? Is there sufficient cover over the refuse?

INSTRUCTIONS:

5. Restart the tape and read again the description of the Zilker Park Landfill. Then STOP THE TAPE and evaluate the landfill by checking Favorable or Unfavorable for each of the factors in the chart under Frame 2.

Frame 2

Evaluate the Zilker Park Landfill by checking the appropriate box below. (USE STUDENT RESPONSE SHEETS)

Factors	Favorable	Unfavorable
Topography		
Type of unconsolidated material		
Thickness of unconsolidated material above shallowest aquifer		
Type of bedrock		
Sources and potential sources of ground water		

INSTRUCTIONS:

6. Restart the tape and listen until told to answer the questions under Frame 3. Then STOP THE TAPE and answer the questions.

Frame 3

(USE STUDENT RESPONSE SHEETS)

a. When Zilker Park Landfill was closed, it was leveled. What evidence of settling do you observe?

b. Is there evidence that the final soil cover for the landfill has eroded?

c. Where has the greatest amount of settling occurred?

INSTRUCTIONS:

7. Restart the tape and listen until told to answer the question under Frame 4. Then STOP THE TAPE and answer the question.

Frame 4

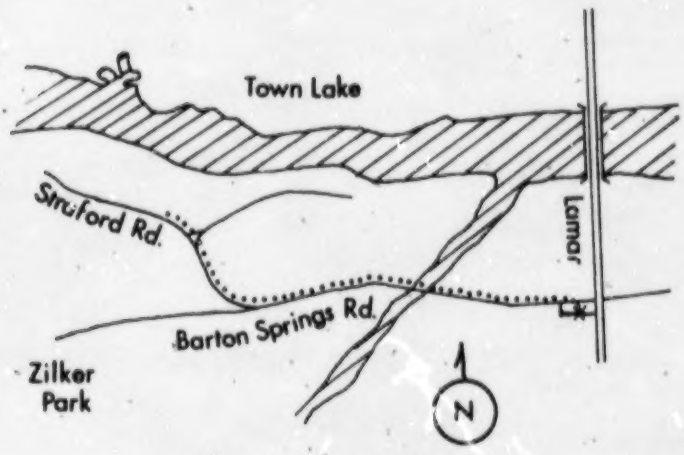
(USE STUDENT RESPONSE SHEETS)

How effectively will rain drain off this site?

INSTRUCTIONS:

8. Restart the tape and listen until told to follow the directions to Stop 2. Then STOP THE TAPE and proceed to Stop 2 according to the directions which follow.

STOP 2 DEL RIO CLAY OUTCROP



Return on Barton Springs Road to South Lamar. On the SOUTH side of Barton Springs Road just before Lamar Street is an outcrop of Del Rio Clay covered by a thin layer of Buda Limestone. Park your car at a convenient location along the side of the road.

INSTRUCTIONS:

9. Restart the tape and listen until told to answer the question found in Frame 5. Then STOP THE TAPE and answer the question.

Frame 5

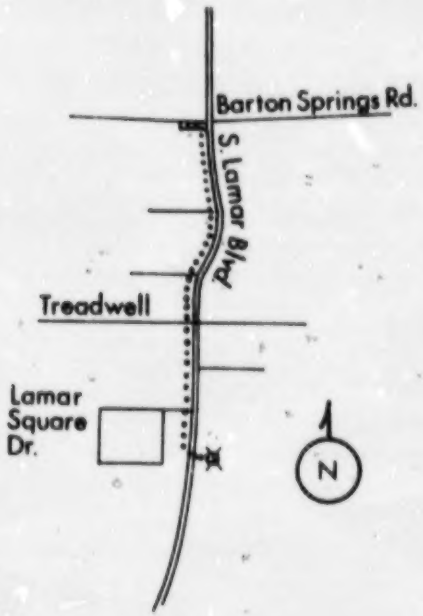
(USE STUDENT RESPONSE SHEETS)

What do you predict will be the changes that will occur during the next several years at the fresh outcrop of Del Rio Clay at the corner of South Lamar and Barton Springs Road?

INSTRUCTIONS:

10. Restart the tape and listen until told to follow the directions to Stop 3. Then STOP THE TAPE and proceed to Stop 3 according to the directions which follow.

STOP 3 SOUTH LAMAR CEMENT DUMP



From the corner of South Lamar and Barton Springs Road, travel 0.6 miles and park at Hicks Mobile Homes which is on the LEFT side of the road. Directly SOUTH of Hicks Mobile Homes is the cement dump.

INSTRUCTIONS:

11. When you are at Stop 3, restart the tape and listen until told to answer the questions found in Frame 6. Then STOP THE TAPE and answer the questions.

Frame 6

(USE STUDENT RESPONSE SHEETS)

a. What effects of the cement dump on the wildlife of this valley can you observe?

b. What effects of the cement dump on West Bouldin Creek can you observe?

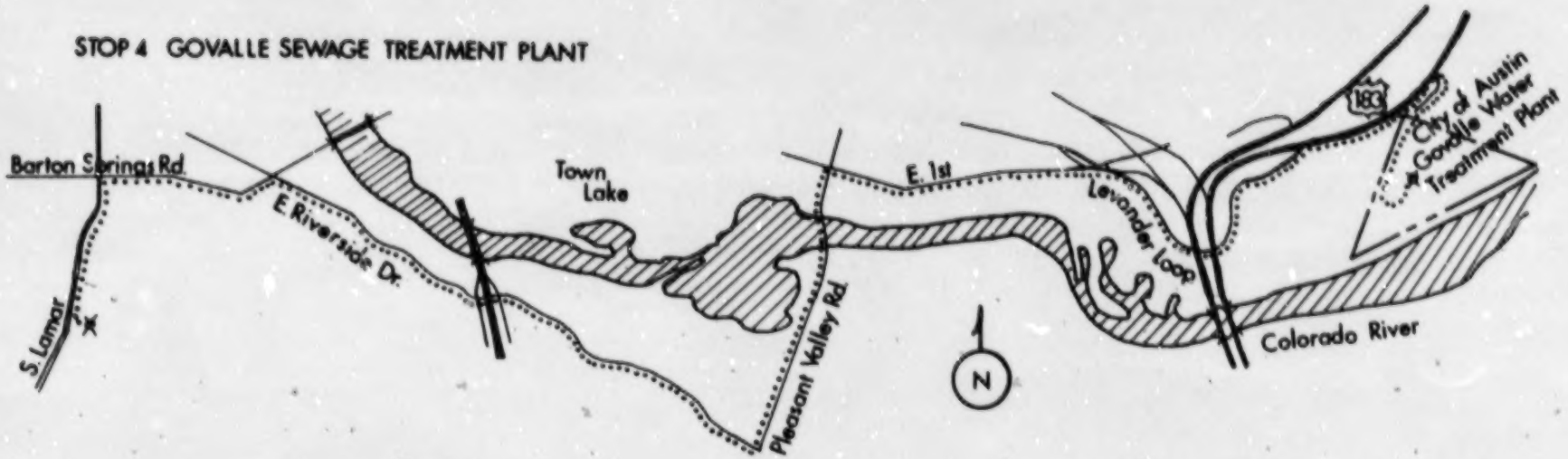
c. What ideas do you have for a replacement of this cement dump?

d. What could be done to improve this site now that it is created?

INSTRUCTIONS:

12. Restart the tape and listen until told to proceed to Stop 4. Then STOP THE TAPE and proceed to Stop 4 according to the directions which follow.

STOP 4 GOVALLE SEWAGE TREATMENT PLANT



NOTE: Gates open from 6-6 every day.

From the South Lamar Cement Dump, return NORTHWARD to Barton Springs Road. Turn RIGHT on Barton Springs Road and go EASTWARD 0.6 miles to Riverside Drive. Bear RIGHT on Riverside Drive and continue EASTWARD for 2.5 miles to Pleasant Valley Road. Turn LEFT on Pleasant Valley Road and go 1.5 miles to East First Street. Turn RIGHT on East First Street and go 1 mile to Levander Loop (marked 183N). Levander Loop will join 183N in 0.9 miles. Continue on 183N for 0.35 miles to an unmarked exit. The Govalle Sewage Treatment Plant exit is on the RIGHT. Follow the asphalt drive which takes you around to the parking area. Unfortunately, permission cannot be granted to walk through the facilities; however, from the parking lot you can look down on each stage of the operation.

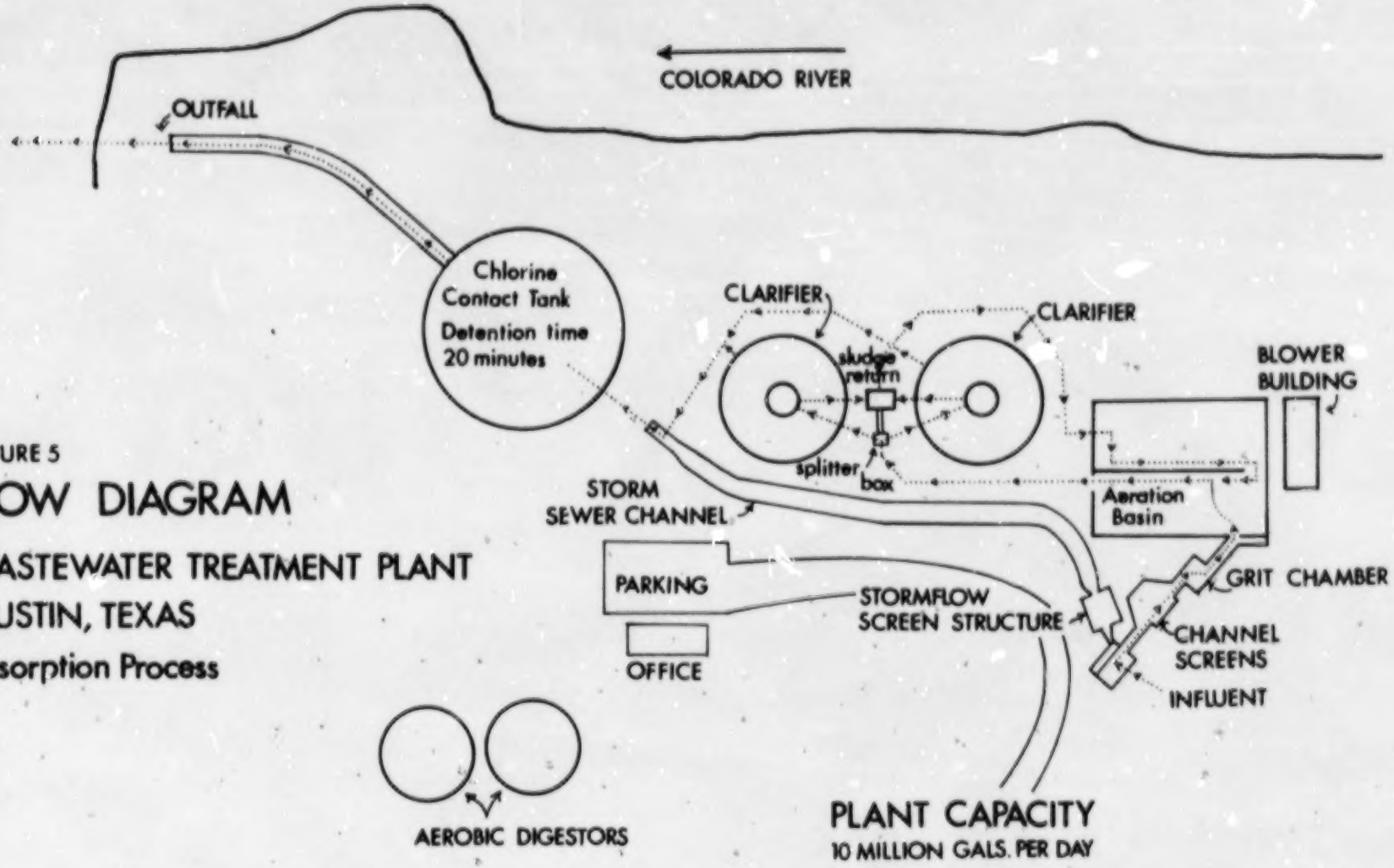


FIGURE 5

FLOW DIAGRAM

WASTEWATER TREATMENT PLANT

AUSTIN, TEXAS

Bisorption Process

INSTRUCTIONS:

13. When you have reached Stop 4, study the Flow Diagram of the Waste Water Treatment Plant in Figure 5. Restart the tape and listen until told to answer the question in Frame 7. Then STOP THE TAPE and answer the question.

Frame 7

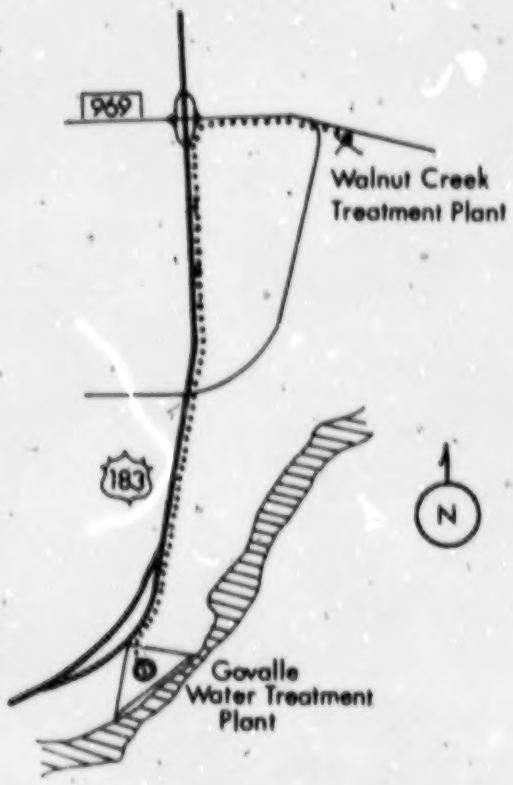
(USE STUDENT RESPONSE SHEETS)

Describe the three stages of operation in a Biosorption Sewage Treatment Plant.

INSTRUCTIONS:

14. Restart the tape and listen until told to go to Stop 5. Then STOP THE TAPE and proceed to Stop 5 according to the directions that follow.

STOP 5 WALNUT CREEK TREATMENT PLANT



From Govalle Sewage Treatment Plant, travel NORTHWARD on 183 for 2.2 miles to Route 969 (Webberville Road). Turn RIGHT on 969 and continue for 0.7 miles. Walnut Creek Treatment Plant is on the RIGHT. There are two entrances. The second entrance, by a white farm house, is always open until 4:00 p.m.

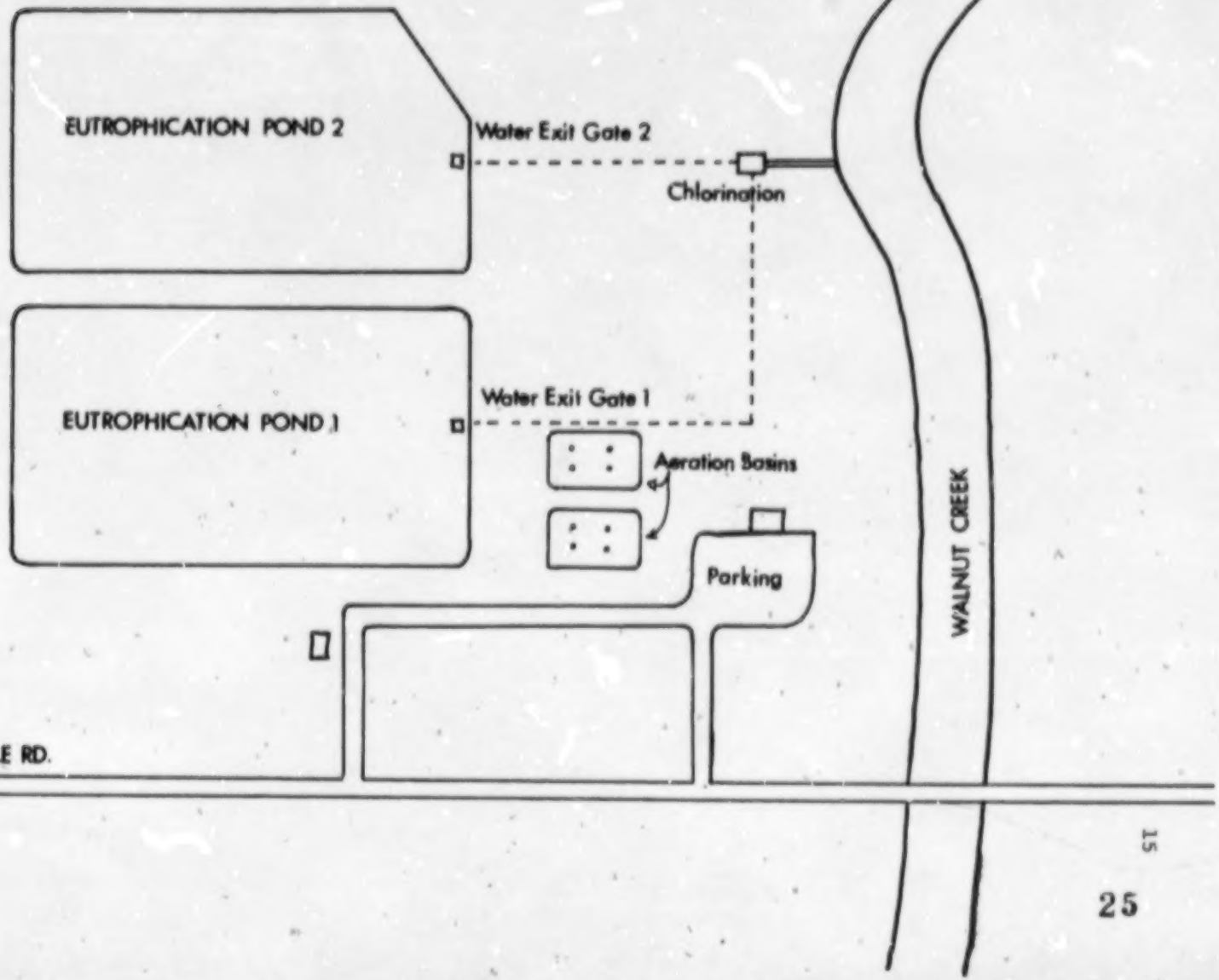


FIGURE 6
WALNUT CREEK
EUTROPHICATION
SEWAGE TREATMENT
PLANT

INSTRUCTIONS:

15. When you have reached Stop 5, study the diagram of the Walnut Creek Eutrophication Sewage Treatment Plant in Figure 6. Restart the tape and listen until told to answer the questions in Frames 8 and 9. Then STOP THE TAPE and answer the questions.

Frame 8

(USE STUDENT RESPONSE SHEETS)

Name and describe each of the three stages in the Eutrophication process.

Frame 9

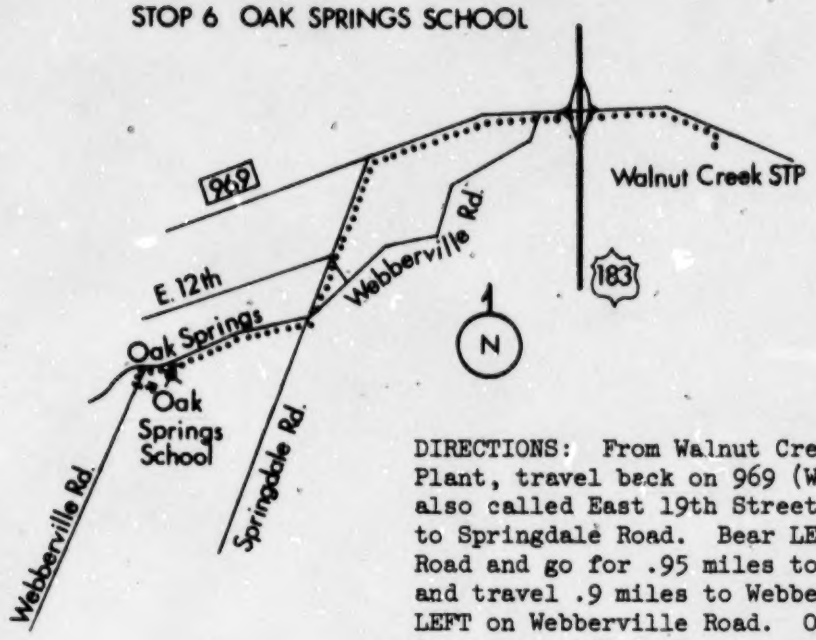
(USE STUDENT RESPONSE SHEETS)

Name one advantage and one disadvantage of Biosorption systems and Eutrophication systems.

INSTRUCTIONS:

16. Restart the tape and listen until you are told to go to Stop 6. Then STOP THE TAPE and proceed to Stop 6 according to the directions which follow.

STOP 6 OAK SPRINGS SCHOOL



DIRECTIONS: From Walnut Creek Water Treatment Plant, travel back on 969 (Webberville Road, also called East 19th Street) for 1.85 miles to Springdale Road. Bear LEFT on Springdale Road and go for .95 miles to Oak Springs Drive and travel .9 miles to Webberville Road. Turn LEFT on Webberville Road. Oak Springs School is on your LEFT. Park at the school parking lot.

INSTRUCTIONS:

17. When you have arrived at Stop 6, restart the tape and listen until told to answer the questions in Frame 10. Then STOP THE TAPE and answer the questions.

Frame 10

(USE STUDENT RESPONSE SHEETS)

a. What observation of the apartment buildings in the Model Cities area indicates to you that the Taylor Clay is not stable?

b. What could have been done to keep these buildings from settling?

INSTRUCTIONS:

18. Restart the tape and listen until the conclusion of the tape. Then STOP THE TAPE and answer the question in Frame 11.

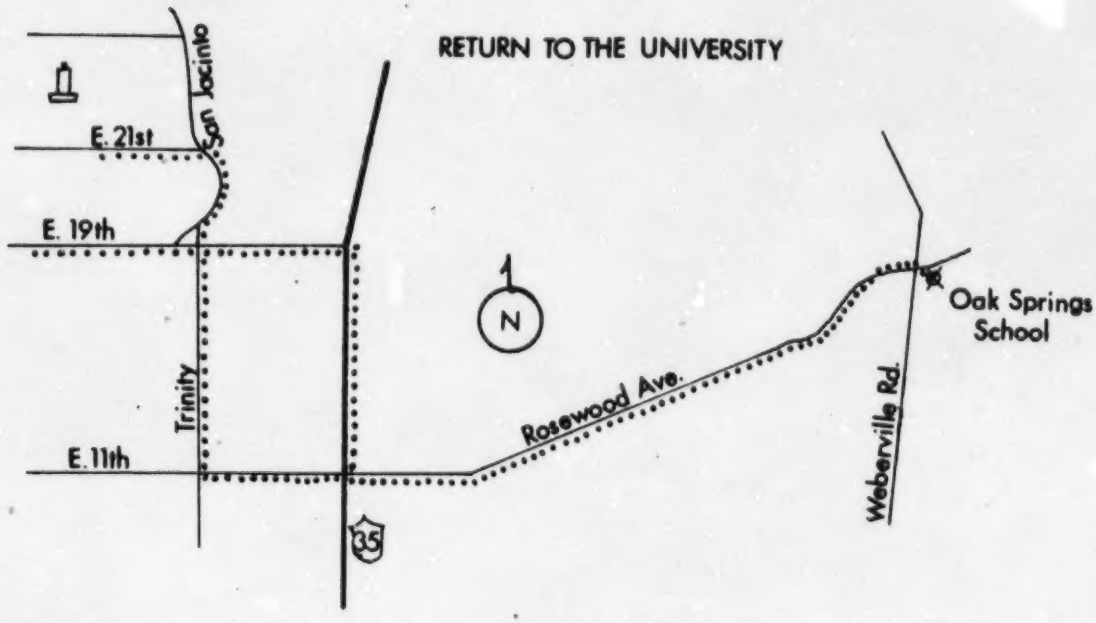
Frame 11

(USE STUDENT RESPONSE SHEETS)

What recommendations would you like to suggest to the Austin City Council?

INSTRUCTIONS:

19. Return to the University according to the directions that follow. Then return the audio cassette tape player and tape to your Instructor or Proctor.



DIRECTIONS: To return to the University, travel WESTWARD on Oak Springs Drive which becomes first Rosewood Avenue and then East 11th Street. 11th Street will take you toward downtown Austin. Choose your most convenient route to the University from that point.

ANSWERS TO QUESTIONS IN STUDY GUIDE

FRAME 1 Answers

Flooding, zoning, solid waste disposal, sewage, urban renewal, rodent and insect control, air pollution, chemical waste disposal, energy needs

FRAME 2 Answers

Topography	Unfavorable
Type of unconsolidated material	Unfavorable
Thickness of unconsolidated material above shallowest aquifer	Unfavorable
Type of bedrock	Unfavorable
Sources and potential sources of ground water	Favorable

FRAME 3 Answers

a. The uneven appearance indicates settling. The borders of the landfill can be determined by noticing the border of the settling.

b. Glass and other garbage has reached the surface.

c. Settling in some locations is as much as 10 feet.

FRAME 4 Answers

Rainfall water is channeled toward the lily pond where it is given an opportunity to settle through the refuse. By looking at the bank of Town Lake the leachate can be seen entering the lake.

FRAME 5 Answers

Over the next several years, the weight of the unsupported Buda Limestone will cause the Del Rio Clay to give. The result is that the blocks of Buda Limestone will break off and slump down the outcrop.

FRAME 6 Answers

a. The cement covering the soil has eliminated the chance of water getting into the soil to the roots of the trees and plants. The result is all vegetation has died, in turn destroying the availability of food for animal life.

b. Water carrying cement washings enters West Bouldin Creek. This effects the pH of the stream water. The cement surface on the side of the valley increases rapid runoff of rainwater into the stream rather than the absorption of water by soil with a heavy vegetation covering.

c. Possible Ideas

1. Perhaps public parks and recreation areas could use the cement for walks, drives, or permanent structures.
2. Public service organizations could make attractive yard decorations, etc., as a money-making project.

We would like to hear your ideas.

d. As in a landfill site, once a cement dump is completed it is very difficult to reverse the damage. Perhaps a wall could be constructed with more cement which would result in a flat area overlooking the valley. If wildlife could be encouraged to come back into the valley, this could be an attractive area.

FRAME 7 Answers

Stage 1: Screening, Grit Removal, and Settling of Solid Material
Large objects such as tree limbs are removed with large automatic rakes. Smaller objects are removed in the grit chamber. The remaining heavy solids settle as the water flow is decreased.

Stage 2: Aeration or Settling of Organic Waste
The sewage is pumped with air to mix the material and permit oxygen to break down the organic material. The organic material then settles to the bottom of the clarifier. Floating solids are skimmed off at the clarifier.

Stage 3: Chlorination
The effluent is treated with chlorine to kill the bacteria and the water is then discharged in the river.

FRAME 8 Answers

Stage 1: Aeration
The sewage is agitated to increase the oxygen content.

Stage 2: Eutrophication
The sewage is pumped into Eutrophication ponds where the bacteria breaks down the nitrates and phosphates in the water. The solids settle out, giving a clean effluent.

Stage 3: Chlorination
Chlorine is added to the water to kill the bacteria before the water enters the Colorado River.

FRAME 9 Answers

	Advantage	Disadvantage
Biosorption	Requires less land	Effluent is higher in phosphates and nitrates
Eutrophication	Effluent is lower in phosphates and nitrates	Requires much more land

FRAME 10 Answers

a. Bricks show evidence of repair from cracking. Large areas have been totally replaced.

b. If foundations had been sufficiently reinforced so that cracking would not have occurred, the damage would have been reduced.

FRAME 11 Answers

Your suggestions will be considered at the next class discussion meeting.

GLOSSARY

aeration: the process of bringing air into close contact with a liquid by passing finely divided air through that liquid.

aquifer: stratum or zone below the surface of the earth capable of producing water as from a well.

clarifier: a large container in which the suspended solids are separated from the water in the Biosorption sewage treatment process.

compaction: decrease in volume of material, as a result of compressive stress.

digester: the chamber in which biochemical decomposition of organic matter takes place, resulting in the formation of minerals and simpler organic compounds.

effluent: the liquid flowing out of a tank or other container.

formation: a defined unit of rock consisting of a succession of strata useful for mapping or description.

ground water: water below the surface of the earth filling the pores and joints in the earth or rock.

influent: the liquid flowing into a tank or other container.

leachate: ground water rich in dissolved chemical materials through which ground water has permeated.

permeability: the capacity of rock for transmitting water.

pH: a measure of Hydrogen ion concentration in a fluid; a high pH indicates a base; a low pH indicates an acid.

sanitary landfill: a landfill in which the refuse is compacted and covered with soil daily.

soil instability: the tendency of a soil to flow when force is applied.

topography: the physical surface features of a region; relief and contour of the land.

unconsolidated material: loose materials on the earth's surface; distinct from rock in that particles are not cemented together.

SCRIPT FOR LEARNING CARREL LESSON

6.3

URBAN CRISIS

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department of Geological Sciences and the Science Education Center

THE UNIVERSITY OF TEXAS AT AUSTIN

"URBAN CRISIS" Learning Carrel Lesson 6.3

Welcome to this final segment in a three part series about man's effects on nature. This lesson entitled "Urban Crisis" will direct you on a field trip to six locations around Austin which demonstrate problems which are common to most municipalities in the United States today. If you have not done so already, please read the first two pages of the Study Guide which will give you the background for this field trip.

Stop the tape now.

The realization of the significance of environmental control and planning is forcing city governments around the country to concentrate much of their attention to this area. In Frame 1 of the Study Guide list some problems that you think a city government faces in attempting to keep the environment clean and healthy for it's citizens. After you have completed this exercise, read the material which begins in the middle of page 3.

Stop the tape now.

Turn to page 5 in the Study Guide. Figure 1 at the top of the page pictures a method of disposing of solid wastes known as the Area Landfill. As you can see, the solid wastes are placed on the land, a bulldozer or similar equipment spreads and compacts the waste, then the wastes are covered with a layer of earth and finally the earth cover is compacted. The Area Landfill is best suited for marshes, flat areas, or gently sloping land and is also used in quarries, ravines, valleys, or where other suitable land depressions exist. Normally the earth cover material is hauled in or obtained from adjacent areas.

Now look at Figure 2 at the bottom of page 5. In a Trench Landfill, as shown here, a long narrow bed is cut in the ground and the solid wastes are then spread in thin layers, compacted, and covered with earth excavated from the trench. The Trench Landfill is best suited for flat or gently sloping land where the water table is not near the ground surface. The advantage to this method is that normally the material excavated from the trench can be used for cover with a minimum of hauling. A disadvantage is that more than one piece of machinery may be necessary.

Figure 3 on page 6 of the Study Guide shows the Ramp Variation Landfill. Here the solid wastes are dumped on the side of an existing slope, and after spreading the material in thin layers on the slope, the bulldozing equipment compacts it. The cover material, usually obtained just ahead of the working face, is spread on the ramp and compacted. This variation is generally suited to all areas, having the advantage of utilizing only one piece of equipment to perform all operations, and makes the Ramp Landfill particularly applicable to smaller operations.

You will note that all three methods of landfill use the technique of compaction. Compaction is an important phase in the sanitary landfill operation because it decreases the degree of settling that occurs after the site is closed. Solid waste should be spread in layers about two feet thick

and compacted with steel wheel compactors. The City of Austin once operated a landfill at Zilker Park. This site, closed since 1967, will be your first stop on the field trip.

Stop the tape and following the directions given in your Study Guide on page 7, drive to Stop 1. When you are at the site, restart the tape.

You should now be at the Zilker Park Landfill. There are many factors which must be considered before building a landfill such as the one you see here. One such factor is the potential danger of ground and surface water pollution. Solid wastes ordinarily contain many contaminants and often infectious materials. These can produce serious health hazards or nuisances if permitted to enter water supplies. Site selection should, therefore, include a geological investigation of the site to determine the potential of either ground or surface water pollutants. The ground water table must be located and information obtained on the historical "high" ground water level and on the general movement of the ground water. The geological investigation should also examine the topography of the site itself and the surrounding area for potential flooding conditions of the site during heavy rains and snow melts. Flooding and surface water drainage can quickly erode the cover material and the refuse fill. Special attention should be given to low lying sites that might be drainage basins for surrounding areas. Sites located near rivers, streams, or lakes are usually considered unfavorable. Neither should a landfill be located in a flood plain because of the water pollution hazard, and because such sites are unusable both during and for a period following flood conditions.

Figure 4 on page 8 of the Study Guide lists five hydrologic criteria for evaluating landfill sites. Read through this chart carefully because you will be asked later to evaluate the Zilker Park Landfill site in relation to each of these five factors.

Stop the tape and study this chart now. Restart the tape when you have read the material.

Now read the description of the Zilker Park Landfill at the bottom of page 8 in your Study Guide. Then look at Frame 2 on the following page. Mark each of the five factors listed in Frame 2 as either favorable or unfavorable in relation to Zilker Park.

Stop the recorder until you have completed this activity.

Earlier we mentioned the importance of compaction in preventing the settling of the landfill. When this site was closed in 1967, it was leveled. In Frame 3 of the Study Guide, briefly note any evidence of settling which has occurred since then.

Stop the tape now and restart when you are ready to continue.

Landfills should slope from one to two degrees to that rainwater will run off the surface rather than collect in a low area. Was this landfill sloped? In Frame 4 of the Study Guide, briefly describe the evidence which would indicated that Zilker Park was or was not sloped.

Stop the tape now and when you have completed your answer restart the tape.

Obviously, Zilker Park Landfill was not developed using sound sanitary landfill practices. In fact, its operation has probably produced more problems for the city than it started with. And what's more, once a landfill is created, the expense of correcting errors or removing the site is prohibitive. Following the directions in your Study Guide on page 10, continue to Stop 2.

Stop the tape now and restart it when you have reached your next destination.

This will be a short but interesting stop. This corner has been cut back to make room for a gas station. In the outcrop, you can easily see the Del Rio Clay which extends up from the base and the Buda Limestone which extends down from the top. The Del Rio Clay found here at the bottom of the structure is known to be a formation which will flow easily when a slight pressure is applied. What do you think will happen over the next several years to this location? Look back along Barton Springs Road at the areas that have been cut back in previous years. What has happened there? Answer the question found in Frame 5 of your Study Guide.

Stop the tape now and restart when you are ready to continue.

You are now ready to drive to Stop 3. As you are driving there, be sure to notice the outcrop of Buda Limestone behind the Texaco gas station shortly after your turn on South Lamar. At this location, the Del Rio Clay is confined below the road level, hence the Buda Limestone is much more stable and not nearly as many rocks have fallen.

Stop the recorder now and restart when you reach Stop 3.

You should now be located at the South Lamar cement dump. This is the site at which cement trucks in South Austin may dump any excess cement left over from a delivery. Drivers can simply empty their cement down into the valley and rinse out their truck. The owner of the property permits the dumping because it has resulted in a fifty feet extension of the parking lot from its original size and therefore has increased the location's value as a business site. While a usable area may be advantageous to the owner of this property, what about the effects on the wildlife who live in the valley and in West Bouldin Creek below? What about the fact that the cement covering the soil in the valley and creek areas has eliminated the possibility of water penetrating into the soil to the roots of the trees and other plant life? This has not only killed all the plant life, but has decreased the availability of food for animal life. The cement dumping has also increased the run-off into the stream after heavy rains. A real need for a convenient area for cement trucks to discard excess cement must be conceded. However, is this location, this procedure, the best solution? What other methods could be instituted to replace this site and this operation, and what could be done to improve this site now that it is created?

Stop the recorder and complete Frame 6 in the Study Guide. When you are ready to continue, restart the tape.

We will be interested to see what ideas you came up with for replacing and improving this site. We have included a few ideas in the answer sheet, but there must be several others that you can think of. You are now ready to continue to Stop 4. Follow the directions given on page 12 of your Study Guide and when you are at the next stop, restart the tape.

You should now be located at the Govalle Sewage Treatment Plant. For many centuries people have known that human wastes must be disposed of in order to prevent dangerous disease and to maintain comfortable surroundings in which to live. The methods used in the collection and disposal of wastes have changed as civilization has advanced and as our knowledge of waste collection and treatment has progressed. The transportation of wastes by water carrier is nature's way of removing wastes from the earth's surface. Rains wash impurities into streams to be ultimately carried to the ocean. Physical, chemical, and biological forces in nature combine to decompose and change objectionable organic materials to stable and harmless products. This natural waste removal might be sufficient in areas of sparse or no population. It cannot, however, be depended upon as a safe method of disposal in the more populated areas or urban communities. In order to protect people from spread of disease and to prevent nuisance and discomforts, the wastes of a community must be collected and treated by processes designed to assist nature in rendering them harmless. The amount of sewage that can be expected in a community will depend on several factors. Abundance of the water supply, economic conditions, and climate. The amount varies, but in the Austin area it averages about 100 gallons per person per day.

In order to accomplish proper sewage disposal in any community, the sewage must be transported to the treatment plant. In the city of Austin, the collection system consists of 790 miles of pipe. There are generally two types of sewage treatment plants. The Govalle plant is a Biosorption treatment plant. Later we will visit the other type of plant, the Eutrophication treatment plant. Unfortunately, city visitation policy will not permit visitors to walk through the plant. From the parking lot, however, you can observe the entire operation. Behind you is the office and the older part of the sewage treatment facilities. You will observe the operation of the new facility which is, by the way, identical to the older facility.

To follow this operation, turn to Figure 5 on page 13 in your Study Guide. Here at Govalle, the complete sewage treatment operation is accomplished in three stages. The first stage consists of screening, grit removal, and settling of the solid materials. The green building to your far right is the location for the three screeners. The smaller particles, the grits, are removed in the grit chamber located just to the left of the screening chamber. After the grits are removed, the rate of water flow is reduced, permitting the heavier solids to settle and the lighter particles to float. The lighter objects are buried along with the screenings and the grits. The heavier solids are pumped to large tanks called "digesters" where bacteria decompose the organic materials so that it can be disposed of without creating a nuisance.

The second stage involves the processes of aeration and settling of organic materials. The aeration takes place in the large aeration basin, the large basin with the steel supports. Over a period of approximately four hours, about one cubic foot of air is pumped into one gallon of sewage. The action in the aeration basin does two things. First, it forms a sludge to carry the

suspended materials down the clarifiers, those circular basins directly in front of you. Second, the action of bacteria oxidizes organic matter and changes it into solids that will settle out. In the clarifier, the sludge will separate readily from the water and settle to the bottom, permitting the clear water, the affluent, to be discharged [illegible] chlorine content tank. Some of the sludge from the bottom is pumped [illegible] to the aeration tank, where it is mixed with the raw sewage entering the aeration basin. The remaining sludge is pumped to oxidation ponds where bacteria converts the sludge to more stable compounds and carbon dioxide.

The third stage is carried out at the chlorine content tank, that large circular basin to your left. Chlorine is added for disinfecting the affluent before it is discharged into the Colorado River.

Now stop the tape and answer the question in Frame 7 in your Study Guide. When you have completed your response, please restart the tape.

The cement canal in front of the two clarifiers is used as a storm sewer. Many of the sewers in Austin follow stream channels. The result is that when heavy rains occur, the streams flow over the manhole covers and actually lift off many of these covers by the force of hydrostatic pressure. Stream water then fills the sewer lines so that more water is brought to the sewage plant than can be efficiently handled. This overflow bypasses the first two stages of the plant, but is treated with chlorine and discharged into the river. You have now seen the biosorption system of sewage treatment. Next you will examine the eutrophication system, Austin's Walnut Creek operation.

Stop the tape now and following the directions on page 14 of your Study Guide, continue to Stop 5.

Your location should now be the Walnut Creek sewage plant. The differences between the two operations are obvious, aren't they? Let's go through this operation and compare it with the Govalle system. Figure 6 on page 15 of the Study Guide shows the plant. Here again, there are three stages of operation. First, aeration; second, eutrophising ponds; and third, chlorination.

The aeration is accomplished in the two large cement pools with several agitators to increase the oxygen content. The water is confined in the aeration tanks for about three hours, the water is then pumped to the second stage, the large eutrophication ponds. These ponds, covering several acres, are around twenty feet deep.

Eutrophication is the process of bacteriological action on the nitrates and phosphates in the water. The water that leaves this plant has a lower nitrate and phosphate content than either the Govalle Sewage Plant or the Colorado River itself.

The third stage is chlorination, which destroys any bacteria in the water. Before high-phosphate detergents were banned by the City Council, detergent sudsing was such a problem that on windy days suds would flow onto the highway. You can see the situation is not much improved. The problem with the eutrophication process is that it takes up much more land than the biosorption process, and land close to any municipality is expensive.

Stop the recorder and complete Frames 8 and 9 in your Study Guide. When you have completed this exercise, restart the tape.

Although the eutrophication and biosorption plants accomplish the same objective, they each have different techniques and advantages. The eutrophication system is more efficient in reducing the nitrates and phosphates, but it requires much more land area.

Stop the tape now and following the directions on page 17, go to Stop 6. Restart the tape when you arrive there.

You should now be located at the Oak Springs School. This is the border of the Colorado River 1935 flood. The soil toward the Colorado River is terrace sand and gravel. This area is an outcrop of Taylor Clay. The Taylor Clay is a 300 feet thick layer of inconsolidated clay. When pressure is applied, the clay will move to any area of lower resistance. Thus if a structure such as the Model Cities apartments were to be build on this clay, the land surface would eventually give way. Look at the building across the street from the school. What do you see here which would indicate that these buildings are not stable? Write your answer in Frame 10 on page 17 of the Study Guide.

Stop the tape now and then restart when you have completed your answer.

Since the Taylor Clay is 300 feet thick, it is not practical to force supports through it to the bedrock below. However, if the foundation had been stronger, the building would have moved as a unit rather than having several cracks in the foundation and brick wall. Actually, neither alternative is favorable. As you return on Oak Springs Drive, note as you go up the hill that the apartments there are built on gravel rather than the Taylor Clay. The result is that the settling is minimal.

This is the last stop on this field trip. But before you return to the University, think over what you have seen today. What recommendations would you like to suggest to the City Council? Note some of these suggestions in Frame 11 of your Study Guide for discussion at your next class meeting. This concludes the field trip. It is suggested that you review the instructional objectives listed on page 2 in your Study Guide. Check to see that you can fulfill each of them.

Please return this recorder and tape to your Proctor.

LESSON 6.3: URBAN CRISIS

STUDENT RESPONSE SHEETS

Name _____

Date _____

LESSON 6.3: URBAN CRISIS

STUDENT RESPONSE SHEET

Frame 1 List as many different environmental problems as you can think of that a city government must face.

Frame 2 Evaluate the Zilker Park Landfill by checking the appropriate box below.

Factors	Favorable	Unfavorable
Topography		
Type of unconsolidated material		
Thickness of unconsolidated material above shallowest aquifer		
Type of bedrock		
Sources and potential sources of ground water		

Frame 3

a. When Zilker Park Landfill was closed, it was leveled. What evidence of settling do you observe?

b. Is there evidence that the final soil cover for the landfill has eroded?

c. Where has the greatest amount of settling occurred?

Name _____

Date _____

LESSON 6.3: URBAN CRISIS

STUDENT RESPONSE SHEET

Frame 4 How effectively will rain drain off the site?

Frame 5 What do you predict will be the changes that will occur during the next several years at the fresh outcrop of Del Rio Clay at the corner of South Lamar and Barton Springs Road?

Frame 6

a. What effects of the cement dump on the wildlife of this valley can you observe?

b. What effects of the cement dump on West Bouldin Creek can you observe?

c. What ideas do you have for a replacement of this cement dump?

d. What could be done to improve this site now that it is created?

Name _____

Date _____

LESSON 6.3: URBAN CRISIS

STUDENT RESPONSE SHEET

Frame 7 Describe the three stages of operation in a Biosorption Sewage Treatment Plant.

1.

2.

3.

Frame 8 Name and describe each of the three stages in the Eutrophication process.

1.

2.

3.

Name _____

Date _____

LESSON 6.3: URBAN CRISIS

STUDENT RESPONSE SHEET

Frame 9 Name one advantage and one disadvantage of biosorption systems and Eutrophication systems.

System	Advantage	Disadvantage
Biosorption		
Eutrophication		

Frame 10

a. What observations of the apartment buildings in the Model Cities area indicates to you that the Taylor Clay is not stable?

b. What could have been done to keep these buildings from settling?

Frame 11 What recommendations would you like to suggest to the Austin City Council?